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CASE REPORT

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Cardiac arrest in a soccer player: a unique case of anomalous coronary origin detected by 16-row multislice computed tomography coronary angiography

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Abstract Anomalous origin of the coronary arteries may be present in otherwise normal subjects without clinical significance, but can also be the cause of myocardial ischemia and sudden death in both adults and teenagers. In particular, the origin of the left main coronary artery or left anterior descending artery from the right sinus of Valsalva or right coronary artery may result in compression of the vessel during or immediately after exercise. We present a unique case of coronary anomaly with four separate coronary ostia originating from the right coronary sinus in a soccer player with sudden cardiac arrest. Multislice contrast-enhanced computed tomography has emerged as a valid noninvasive method for the diagnosis of coronary artery anomaly.

Key words Cardiac arrest · Multislice computed tomography · Coronary angiography · Exercise

Case report

A 51-year-old man with a history of recurrent exercise-induced syncope was resuscitated during a soccer game after cardiac arrest due to documented ventricular fibrillation. On admission, the conscious patient was asymptomatic with an unremarkable physical examination. ECG revealed sinus tachycardia with nonspecific intraventricular conduction delay, ST-depression on anteroseptal leads, and without prolonged corrected QT time. Chest X-ray and biochemical examinations showed no pathological findings and negative troponin T.

His ventriculogram showed a preserved left ventricular systolic function with discrete anterolateral and diaphragmatic hypokinesia. The dominant right coronary artery (RCA) showed a localized dissection in its proximal segment without any impact on flow (Fig. 1). The left anterior descending artery (LAD) describing an “anterior dot sign,” the circumflex (Cx), and a small septal branch arose with separate ostia from the right coronary sinus.

Sixteen-row multislice computed tomography (MSCT) confirmed the course of the anomalous coronary arteries originating with separate ostia from the right coronary sinus (Fig. 2). The LAD coursed anteriorly to the pulmonary artery, a small septal branch coursed between the aorta and the pulmonary artery, and the Cx coursed between the aorta and the pulmonary vein. The localized non-flow-limiting dissection in the proximal RCA was also clearly demonstrated by MSCT (Fig. 2, arrow).

An ICD (cardioverter defibrillator) was implanted. Following an uncomplicated hospital course, the patient was discharged and remained asymptomatic.

Discussion

Coronary artery anomalies are infrequent findings which are usually incidentally detected by cardiac catheterization (prevalence 0.3%–1.0%) or at postmortem examination (prevalence 0.3%).¹ An anomaly characterized by all three coronary ostia originating separately from the right coronary cusp is far less commonly reported.

Although most anomalies are minor variations in coronary anatomy without any clinical significance, some anomalies are associated with morbidity and mortality. Therefore, clinicians should be aware of such anomalies as well as their significance and consequences. Several anomalies of the left main coronary artery arising from the right coronary sinus and some anomalies of three separate coronary ostia arising from the right coronary cusp have been reported in the literature,^{2,3} since they particularly increase the risk for severe complications such as

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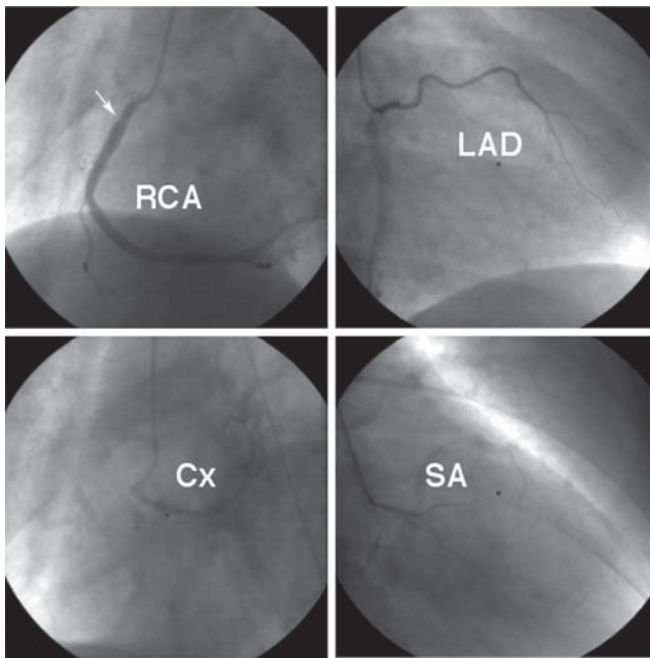


Fig. 1. Coronary angiography demonstrating coronary vessels originating from the right coronary cusp: the left anterior descending coronary (LAD), the circumflex (Cx), and a small septal branch (SA). The right coronary artery (RCA) shows a limited, non-flow-limiting dissection (arrow)

angina pectoris, acute myocardial infarction, or sudden death.

In the present case, although the left system arose entirely from the right cusp, all four vessels had separate ostia. To our knowledge, this is the first report describing four separate coronary artery ostia arising from the right coronary cusp. A specific approach to these patients has not been described in terms of clinical significance and therapy.

Anatomical features

Coronary anomalies are rare incidents in the general population and although most anomalies are without clinical significance, some may be associated with angina pectoris, acute myocardial infarction, heart failure, and sudden cardiac death even in absence of atherosclerosis.^{1,4,5} The most common anomaly is the absence of the left main trunk with separate LAD and LCx ostia (incidence 0.47%). The next most common anomalies are the LCx originating from the right sinus of Valsalva (0.45%), the RCA originating from the ascending aorta above the sinus of Valsalva (0.18%), and the RCA originating from the left sinus of Valsalva (0.13%). The incidence of the LAD originating from the right sinus of Valsalva is 0.02%.⁶

Clinical features

Coronary anomalies can simply be classified as ischemia-producing and non-ischemic. Nonischemic anomalies with-

out a clinical risk include a single coronary anomaly, RCx arising from the right coronary sinus, and separate ostia of all three arteries.⁷ The clinical significance is determined by the type of anomaly, the anatomical course of the artery in relation to the great vessels, and the extent of myocardium supplied by the anomalous artery.

The high-risk ischemia-producing anomalies consist of (i) anomalous origin of one or more coronary arteries arising from the pulmonary trunk, (ii) left main and right coronary artery from the opposite aortic sinus, (iii) single coronary artery, and (iv) hypoplastic coronary arteries.

Several potential mechanisms have been proposed to be associated with ischemia and sudden cardiac death in patients with anomalous coronary arteries from the contralateral sinus of Valsalva. The anatomical course of the anomalous arteries in relation to the great vessels of the aorta and pulmonary trunk (anterior, posterior, and interarterial course) is suggested as one of the possible mechanisms. The anterior and posterior course is thought to be benign. An interarterial course may result in compression of the anomalous coronary artery between the aorta and the pulmonary trunk secondary to dilatation of these great vessels during exercise.⁸ This type of coronary anomaly appears to be the most common cause of sudden death among the congenital coronary malformations in young trained athletes.⁹

The oblique take-off of the anomalous artery producing a slit-like orifice in the aortic wall can collapse like a valve during exercise.^{1,10,11} In a histopathological study,⁸⁻¹⁰ the proximal portions of the anomalous coronaries were documented to be intramural (i.e., within the aortic tunica media), which could further aggravate the coronary obstruction, particularly with expansion of the aorta during exercise.

Vasospasm of the anomalous coronary may also cause ischemia, possibly as a result of endothelial injury.¹² Additionally, the repetitive attacks of ischemia caused by anomalous coronaries may result in myocardial necrosis and fibrosis, which creates an electrically unstable focus predisposing to lethal ventricular arrhythmias.

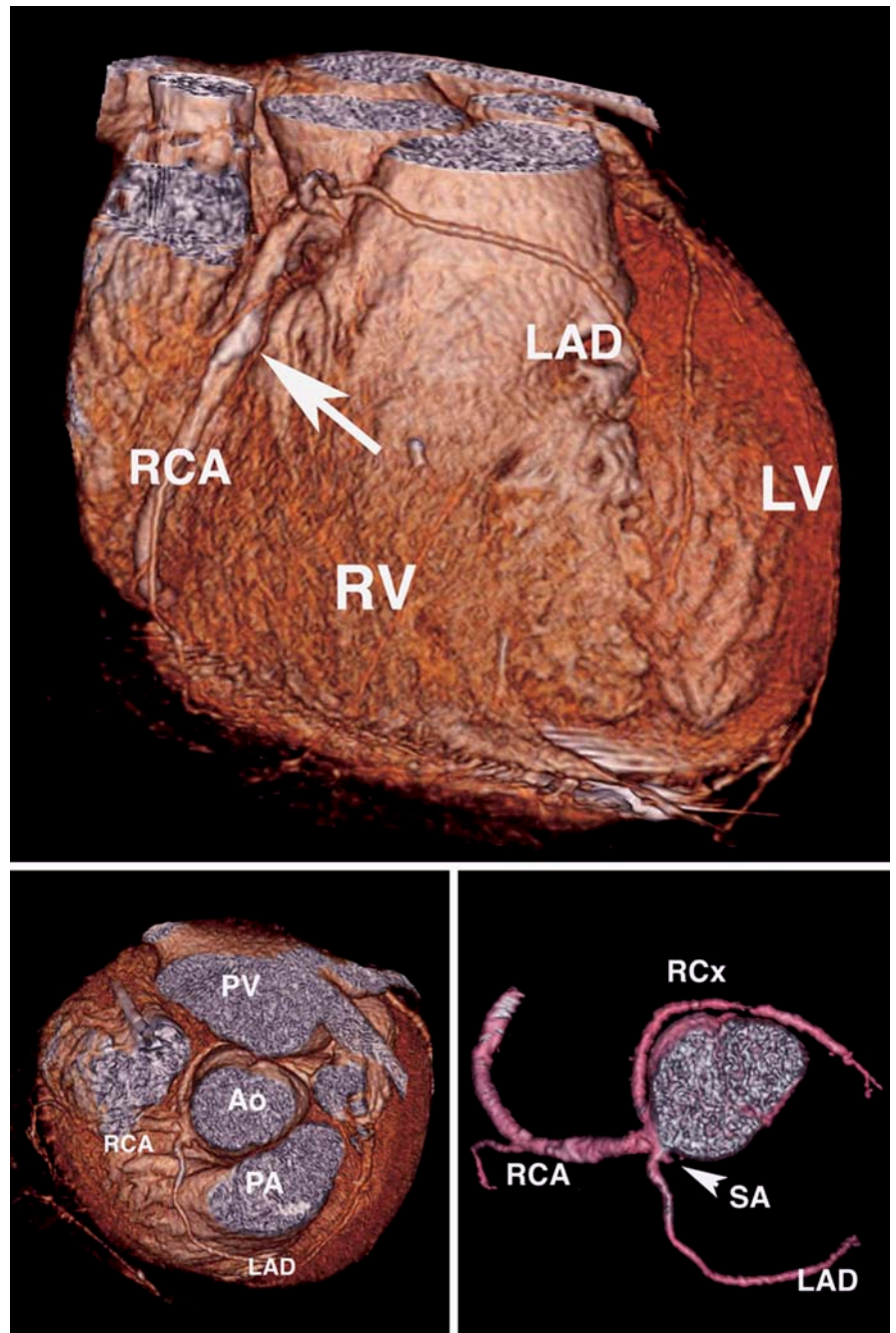
Incidence of cardiac death

A review of 242 patients with isolated coronary anomalies demonstrated cardiac death in 59%, in which 39% were sudden cardiac death.¹³ The incidence of sudden cardiac death related to coronary artery anomalies is reported as 11% in exercising individuals aged 8–66 years, 0.6% in the general population aged under 40 years, and 23% in competitive athletes with a mean age of 17 years.¹⁴ According to the Sudden Death Committee of the American Heart Association, coronary anomalies cause 19% of sudden cardiac deaths in athletes.

Noninvasive diagnostics

Cardiac magnetic resonance imaging (MRI) is a reliable noninvasive imaging and screening modality which avoids

Fig. 2. Three-dimensional reconstructions (volume rendering) based on the isotropic multislice computed tomography angiography data set clarify the relation between the abnormal origin and the course of the coronary arteries and the surrounding structures such as the aorta (*Ao*), the pulmonary artery (*PA*), and pulmonary vein (*PV*). Right (*RV*) and left ventricle (*LV*) are indicated. The arrow (*upper panel*) indicates the non-flow-limiting dissection of the right coronary artery (*RCA*). *RCx*, right circumflex artery; *LAD*, left anterior descending artery; *SA*, small septal branch



radiation and contrast agents. It may be superior to conventional angiography in determining the correct origin of anomalous coronaries and their spatial relationships with the great vessels. Its greatest limitation is determining the distal course of the anomalous coronaries; therefore, combination of MRI with angiography greatly improves vessel definition.^{15,16} Transesophageal echocardiography may also detect coronary anomalies, but it is not entirely noninvasive and the predictive value is low.

As described in the present case, contrast-enhanced computed tomography with three-dimensional reconstruction offers excellent determination of the origin and course of anomalous coronaries and their relationships with the

great vessels. The disadvantages of this technique in comparison to other noninvasive techniques are the requirement of ionizing radiation and potentially nephrotoxic and allergenic contrast agents.

Conclusions

We report a unique case of coronary anomaly associated with sudden cardiac arrest. We documented four separate coronary artery ostia originating from the right coronary cusp. To our knowledge, this is the first report describing this entity.

An interarterial course, possibly resulting in compression of the anomalous coronary artery between the aorta and pulmonary trunk secondary to dilatation of these great vessels during exercise, appears to be a significant cause of sudden arrest among the congenital coronary malformations, as demonstrated by our unique case. Based on our case, the clinical profile of this type of anomaly is malignant, requiring aggressive treatment including ICD implantation and close follow-up.

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